MODELS & SIMULATIONS In Operational Test and Evaluation A Good Idea (?)

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M&S in Operational T&E

- **Policy - Where *CAN* we use M&S?**
- **Practicality - Where *SHOULD* we use M&S?**
  - **Costs**
  - **Benefits**

Policy

What we *CAN'T* do:

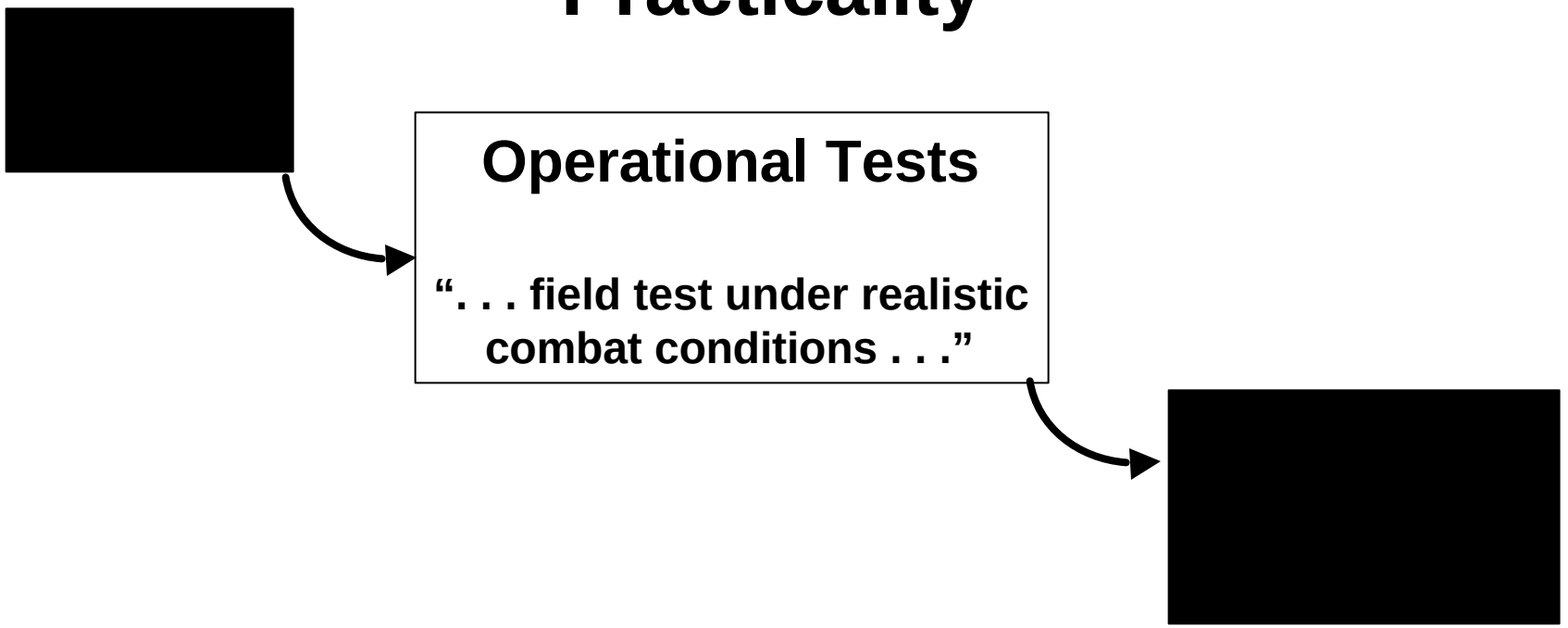
"The term operational test and evaluation . . . does not include an operational assessment based exclusively on (a) computer modeling; (b) simulation; . . . "

- Title 10, U.S. Code

What we *CAN* do:

- **Test planning**
- **Data analysis and evaluation**
  - **Augment test results**
  - **Extend test results**
  - **Enhance test results**
- **Tactics development**
- **Early Operational Assessments (EOAs)**
- **More?**

Practicality



We use M&S today to help us do our business better

- **Using M&S to plan and understand test results makes sense and is clearly cost effective where the models exist**
- **Using M&S to work around range limitations makes sense and can be very cost effective (e.g. miss distance)**
- **Other uses?**

Can We Do More? Should We?

- **Perceptions**
  - **M&S is cheaper than traditional testing on ranges**
    - ***Cost per run for models is very low***
  - **Computer/communications advances improve M&S**
    - ***Video game/Internet have direct application to military***
  - **M&S is key to revolution in system development**
    - ***Simulation Based Acquisition***
- **Realities**
  - **M&S has significant development and recurring costs**
    - ***Reuse is in its infancy - must be fed to become reality***
  - **Training use is spurring investment in technology**
    - ***Promises to improve T&E easily overstated***
  - **Formal M&S has not taken hold in system development**
    - ***T&E dealing with M&S issues that should be solved by developers***

Major AFOTEC M&S Efforts

- **Past**
  - **OTH-B: Estimate effect of sunspots on radar performance**
  - **Terrain Bounce ECM: Estimate effect of different terrain**
  - **B-2: Estimate "survivability"**
  - **EF-111A: Estimate impact on strike aircraft survivability**

- **Future**
  - **JASSM: Estimate Key Performance Parameter**
  - **ABL: Estimate effectiveness against targets**
  - **B-1B DSUP: Estimate ECM robustness**

Results

- **OTH-B**

  Model couldn't be validated with test data

- **EF-111A**

  Model not completed in time to affect decision

- **Terrain Bounce ECM**

  Model could predict failures; couldn't predict successes

- **B-2**

  V&V effort unsuccessful due to simulation error

- **B-1B DSUP**

  Early threat models performing well, but architecture maturity and configuration management are issues

Distributed M&S for Testing

- **JADS program showed that distributed M&S for testing is possible and may well be cost effective *in some cases***
  - **Clearly yes where the cost of architecture is recovered**
    - ***Air-to-air missile architecture offset by reduced missile shots***
    - ***C4ISR architecture useful to other tests and training***
  - **Answer not so clear in EW**
    - ***Problem identification in early development avoids cost - how much?***
- **JADS program showed that infrastructure cost is not just limited to the communications architecture**
  - **Models, human-in-the-loop facilities, hardware-in-the-loop facilities, installed test facilities, and actual hardware are all potential elements**
    - ***Limitations often come down to the limitations of the existing pieces***

General Observations

M&S applications are rarely easy

- **Example: JMASS**
  - ***Initial investment is larger than expected to bring desired capability on-line - - Extensive reuse of models is expected to reduce costs***
  - ***Reuse dilutes focus of effort, adds requirements, increases complexity - - more cost to develop***
  - ***More users stress allocation of resources for architecture development, threat model development, and environment development***

General Observations

M&S is an infrastructure element that competes for resources

- **Example: CV-22**

- **No digital systems model of CV-22 planned by program office or contractor**

  Funded by T&E?

- **No existing digital models of most threat systems**

  GDIP funding not sufficient; funding must come from customers

- **IR environment model not adequate**

  Planned, but not currently available

Conclusion

"We hold these truths to be self evident…"

- **Pick your applications carefully**
  - ***Traditional test methods may be adequate - - use M&S for the right reasons, not because it is popular***
- **Define the specific question to be addressed by M&S**
  - ***Specific questions are needed to guide the process - - may be more demanding than traditional test design***
- **Conduct V&V of those M&S elements that are important to that question**
  - ***Just as in traditional testing, it is necessary to understand the limitations of the M&S elements so that the question is answered with acceptable certainty***